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INTERNATIONAL RESEARCH COUNCIL—THIRD REPORT OF THE COMMISSION APPOINTED TO FURTHER THE STUDY OF SOLAR AND TERRESTRIAL RELATIONSHIPS

By HERBERT H. KIMBALL

[Weather Bureau, Washington, February 3, 1932]

This important report is made up of 40 short papers by 44 different authors, on a great variety of subjects. Three of these are of special interest to meteorologists, as follows:

(1) Report on solar and terrestrial relationships, by C. G. Abbot. In this report the author anticipates some results that will be given in Volume V of the Annals of the Astrophysical Observatory, which is soon to be published, and which will summarize the work of the observatory to the end of the year 1930. Quoting from the report:

The principal features and many details of the sun's variation since 1918 are found to be the sum of five regular periodicities. Their periods are 65, 45, 25, 11, and 8 months. Their amplitudes are 0.014, 0.013, 0.010, 0.009, and 0.005 calorie, respectively. Between times when they all reinforce each other to increase the solar radiation and to decrease it, there is a range of 0.102 calorie, or about 5 per cent. This was not entirely reached at any time since 1918, the nearest approach of about 3 per cent occurring in 1922.

Superposed on this background of fairly permanent long-period periodicities are many periodicities and also irregular solar fluctuations of shorter intervals. Among these are sequences of solar change running their course upward or downward in a week or less. We are able to discriminate these with fair certainty if they exceed 0.45 per cent, by the daily observations of our best station, Montezuma. The other stations show sufficient evidence of correlation to establish a very strong probability of the veridity of these small changes, but have not sufficient accuracy or continuity to duplicate them all as we would like to see them do. However, the *temperatures* of Washington and other stations in the United States show so obvious a dependence upon these sequences of solar variation, discovered in the observations of Montezuma, Chile, as to be an independent verification of them.

(2) Relation of World Weather to solar radiation changes, by H. Helm Clayton.

The author refers to work begun by him in 1916 which showed a correlation between periodicities in weather changes and in solar activity as evidenced by both solar constant values and sunspot relative numbers. In the present paper he states:

The annual solar variation means show an 11-year period, but it is not the dominating period as in the case of sunspots. There are found instead marked oscillations of a few days in length, other oscillations of about 30 weeks, of about 5 months, of 8 months, of 11 months, of 22–28 months, 45 months, etc., which have amplitudes approximately as great as that of the 11-year period.

The temperature and pressure show similar oscillations, and it is of importance to note that these *terrestrial changes show a similarity to solar radiation changes and not to sunspot curves.*

The short periods found approximate to fractions of the 11.25 year sunspot period or the double sunspot period of 22.5 years. It is hence assumed that they are harmonics of this longer period.

For a summary of Clayton's paper we will quote the following paragraph:

MOVING WAVES OF WEATHER

The disentangling of solar influences is rendered very difficult by the discovery that following oscillations in intensity of solar radiation something in the nature of pressure and temperature waves are sent out from certain centers of action, more especially from the polar areas. These moving waves are the chief cause of weather changes. They progress with a velocity proportional to the length of the oscillation of the solar pulsation, that is, oscillations of short duration produce waves which move rapidly and oscillations of long duration produce waves which move slowly. The combined effect is the complex condition found on our weather maps.

In this paragraph the author has given a clear picture of the cause of weather changes in the *pressure and temperature waves sent out from certain centers of action, more especially the polar areas.* The attempt to connect these waves with *oscillations in intensity of solar radiation* requires observational proof, which at present is lacking, and especially as the waves are most pronounced at the season of the year when the polar region from which they appear to move is receiving no solar radiation.

(3) Ultraviolet solar radiation and its relation to the solar constant, solar activity, the ozone content, and the turbidity of the earth's atmosphere, by Walter E. Bernheimer.

In this paper we have the views of an astronomer on the question of solar-constant variations, as follows:

The recently published values of the solar constant make it possible to treat the material to April, 1931. The general march without secondary fluctuations, calculated in like manner as for the ultra-violet solar radiation, is shown in the upper part of Figure 2 (not reproduced). It will be seen that the solar constant reaches a maximum about half a year before sunspot maixmum. The minimum of the smoothed solar constant occurs in April, 1929; after that the values become successively higher, and reach nearly a maximum in the spring of 1931, while sunspot relative numbers in general are falling off from maximum to the approaching minimum in the solar cycle.

It seems therefore as though solar radiation were quite independent of solar activity. A direct comparison between the march of ultra-violet solar radiation and the solar constant * * * reveals a tendency somewhat fatal to the theory that both quantities are correlated and have a common physical source. If the reality of a fluctuation in the total and the ultra-violet radiation should be proved, much further work will be needed to find the cause for the strange fact that solar radiation measured in the main spectrum, and solar radiation measured in the short wavelengths, manifest a quite different behaviour, and that the march of both quantities is obviously not related to the general variations of solar activity. We may also state that aurorae and terrestrial magnetism are the only phenomena which obviously vary in accordance with the solar activity.

During the polar year August, 1932, to August, 1933, inclusive, meteorologists and meteorological services of the world will unite in a study of meteorological conditions in both Arctic and Antarctic regions, with a view to determining their influence upon the weather in lower latitudes. The program includes solar radiation measurements, but hardly of the character that are required to measure solar variability, except as it is reflected in magnetic measurements. The work should, however, shed light upon the origin and movements of the great surges of air that move at frequent intervals from polar to equatorial regions, and vice versa, and which are the cause of the frequent and marked weather changes in middle latitudes.